



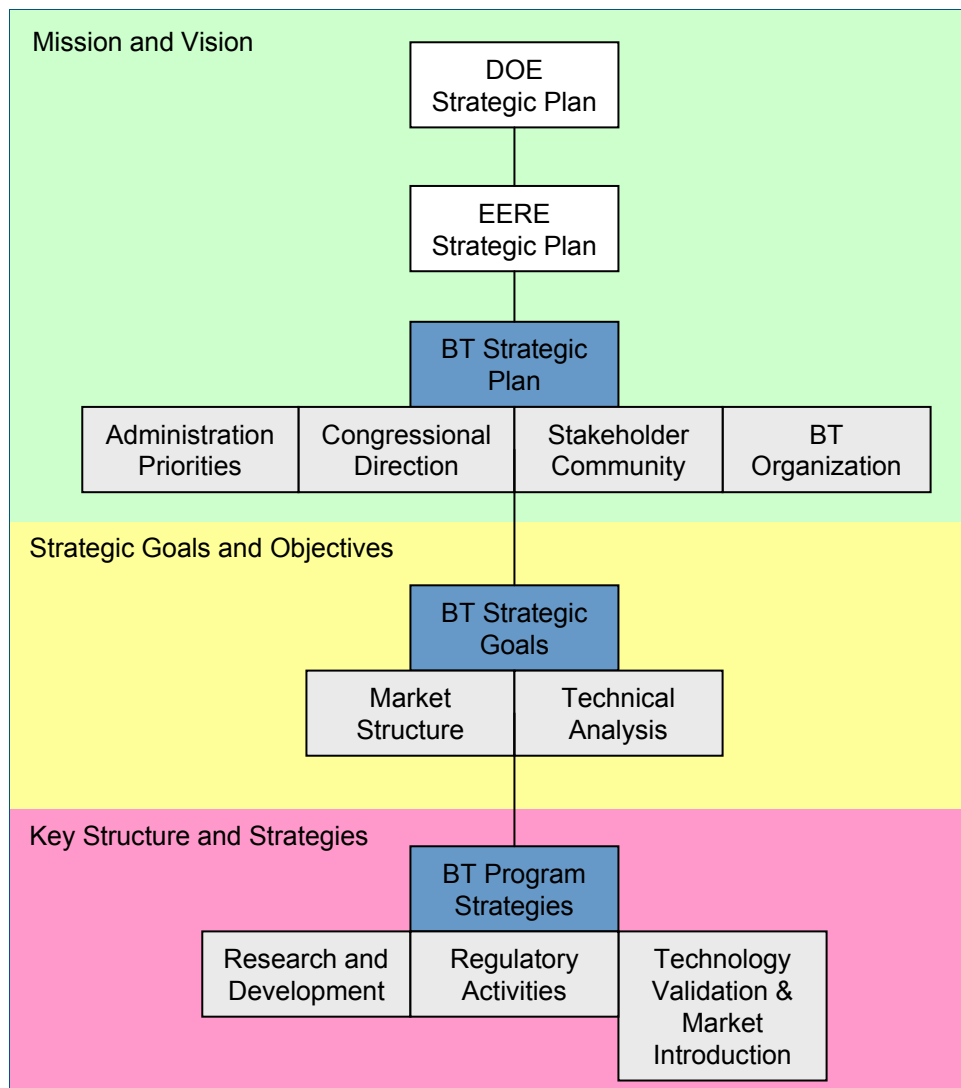
2 Program Critical Functions

This section provides a description of the program's functional structure, as well as the critical functions of the program. Critical functions include portfolio decision making, performance measurement, analytical processes and program evaluation. Also described are the expected program benefits. These critical planning functions are supplemented and supported by the administrative and supporting matters discussed in Chapter 6.

2.1 Program Structure

The Building Technologies Program Structure is shown below:

Figure 2-1 Building Technologies Program Structure



The structure of Building Technologies has evolved through years of strategic planning, which has defined the key elements of the program, including:

- Mission and vision,
- Strategic goals and objectives, and
- Key structure and strategies.

The mission and vision of BT are aligned to strategic objectives in the DOE and EERE strategic plans. The mission and vision are developed in an open and consultative process that includes consideration of administrative priorities, congressional direction, stakeholder community and the BT organization.

The strategic goal(s) are likewise linked to the strategic objectives of EERE. That is, if BT is “...successful in meeting [its] goals and objectives... then, by definition, EERE should be successful in accomplishing its mission”¹ in the buildings area (assuming other Technology Deployment (TD) programs, to the extent they contribute to this mission are also successful). Goals and objectives are also developed in an open and consultative process. Primary direction is set through market structure and relies upon technical analysis to help set goals and to determine the division’s activities.

Strategies are developed that through analysis of technical options and an understanding of the market structure (trends, barriers, institutions, consumer preferences), are most likely to achieve the strategic goals and objectives of each activity. These strategies then form the organizational structure within the BT Program.

2.2 Portfolio Decision-Making Process

Program management, as implemented in the Building Technologies (BT) program, follows EERE best practices as set forth in the Program Management Guide.² The operating principles set fourth by EERE require each program to:³

- Develop an explicit mission and a vision;
- Establish long-term and near-term goals and objectives to achieve the vision and mission;
- Determine strategies to achieve goals and objectives;
- Allocate scarce resources through the budget process among those strategies;
- Track progress and results to ensure that plans are being carried out and the desired outcomes are realized; and
- Review goals and objectives needed to ensure that they are still relevant and that sufficient progress is being made against them.

¹ [*EERE Program Management Quick Reference Guide*, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, September 2001. Hereafter, PM-QRG.](#)

² [*EERE Program Management Guide*, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, September 2001.](#)

³ [PM-QRG](#)



As stated in the Guide, Technology Program Managers, such as the BT Program Manager, are responsible for producing a series of plans against which the program is executed. These plans include:⁴

- Strategic Plans;
- Multi-Year Plans;
- Annual Operating Plans; and
- Approved Funding Programs (Spend Plans).

The process used to develop the plans is as important, or even more important, than the plans themselves. Developing plans, and executing against those plans, is the essence of good program management. As Dwight D. Eisenhower said, “in preparing for battle I have always found that plans are useless, but planning is indispensable.”⁵

2.2.1 Multi-Year Program Plan

Development of the BT Multi-Year Program Plan is the key tool used in the portfolio decision making process. The key elements of the multi-year plan are listed below:

- Discussion of the program logic, which links program outputs to achievement of objectives and ultimately to outputs in the market
- Schedule of key milestones to achieve objectives
- Identification of resources to achieve milestones
- Decision points for completion, graduation, or termination of projects within activities
- Identification of inter-relationships between activities and projects
- Criteria for portfolio balancing and project selection

In developing the multi-year plan, BT begins with the goals, objectives, and strategies as given. Within these strategies, annual targets are identified along the critical path to the program objectives and goals. The annual targets may also represent key decision points for determining as early as possible if the program is on track toward achieving objectives and facilitate timely adjustments to the strategies as needed. Targets are managed within and across project(s). Projects are not just a collection of similar activities focused on a particular objective. Projects provide continuity within a multi-year framework for achieving targets, as well as achieving longer-term objectives and eventually outcomes (impacts in the marketplace). Finally, projects are executed through the Annual Operating Plan (AOP), discussed in Chapter 4.

The multi-year plan identifies baseline conditions, a schedule of key interim targets, and the final objective for each project identified. The targets are measurable against the baseline. Key decision points are identified and discussed based on target or objective attainment (success) or shortfall (failure). Depending on success or failure, plans are

⁴ [PM-QRG](#)

⁵ Dwight D. Eisenhower (1890–1969), US General, President. As quoted by Richard Nixon in “Khrushchev,” *Six Crises* (1962).



developed for graduation, completion, or termination of activities within projects, or projects themselves, as the program moves towards overall goal attainment.

R&D portfolio management provides guidance regarding key issues that need to be addressed and balanced in making investments. These usually include the major R&D issues and gaps that need to be addressed, timing of the payoff for the investment, and other concerns that are important to management and stakeholders.

The objective of R&D portfolio management is to achieve and maintain the optimum balance of investments. The definition of optimum balance of investments depends on the goals, competence, vision and culture of each organization. In the upcoming year, BT will be considering whether additional portfolio characteristics or analytical approaches could be used to improve the R&D portfolio management or provide additional program insights. Such portfolio characteristics could include:

- Risk – understanding technical and implementation risks associated with the project is often useful in balancing investments, particularly R&D investments, where the risks and uncertainties are often significant. The portfolio should include a range of risks and the balance should reflect the nature of the required R&D and the strategy of the program. In addition to risk balance, the portfolio will evolve to be risk managed, where high risk elements on critical paths are addressed early to avoid expenditures on lower risk elements, should the higher risk work fail and necessitate project termination.
- Technology Development Stage (Stage Gate) – research, development, demonstration, commercialization, and information and data development are typical designations for stages of development. A portfolio should contain projects that focus on the areas of most importance to the program. For example, some programs do not include upstream research (because it is not their charter), but instead focus on a mix of development, demonstration, commercialization and informational projects. Other organizations focus on leading edge research and development and have few investments in downstream commercialization or informational projects.
- Value – the estimated potential value of the project is a key factor in making decisions regarding R&D investment. However, value is not captured by a single term. The value for DOE R&D must be comprised of a mixture of elements including such elements as energy savings, environmental benefits, increased electric reliability, capital and operating cost savings, economic benefit, alignment of the project with program's overall strategy, and other factors that the program management team considers important. These are typically assessed separately and combined into a single value.

Two areas of expected focus in the next round of Multi-Year Planning, conducting a risk assessment and implementing a stage gate⁶ process are discussed below.

⁶ Cooper, Robert, *Winning at New Products, Accelerating the Process from Idea to Launch*. 2001: Perseus Books Group. (Unavailable)



2.2.1.1 Risk Assessment

The buildings program primarily addresses research that requires new types of equipment or materials; or which requires new ways of designing efficiency and renewable energy features into existing buildings. Resulting technologies, designs and practices must not only meet energy savings goals, but function reliably in day-to-day building conditions without adverse health, safety, comfort, or productivity impacts. The need to meet multiple technical performance requirements substantially increases the technical risk of these projects.

Additionally, the pursuit of a net-zero energy home will require technologies that do not exist today, which is inherently higher risk than incremental improvement of today's technologies. One example of a high risk area is the solid state lighting initiative. This research is directed towards the development of fundamentally new solid state lighting systems requiring significant technological breakthroughs in areas such as organic light emitting diodes. As a result the overall technical risk for this subprogram is towards the higher end of the component risk.

2.2.1.2 Stage Gate Process

Building Technologies, through its solid state lighting activity, is in the process of developing a stage gate process, which is intended to provide a management tool for portfolio planning. A stage-gate system, tailored to the lighting subprogram, creates a lexicon for discussion, decisions, and planning which is mutually beneficial to the portfolio manager and contractors.

This framework is being developed as a tool to assist in guiding the research, technical and business actions and decisions that are necessary to move a concept from a scientific phenomenon to a marketable product. As a technical concept advances through the continuum of technology stages, it must demonstrate that it meets the criteria at each gate before it advances to the next stage. By constructing this type of framework, DOE intends to ensure that the Department and its contractors are properly reviewing the R&D projects and asking the right questions to lead to successful commercialization of energy-saving products.

In addition, the Department will be cognizant of the stages its contractors are engaged in relative to the overall process of new product development. The stage-gate system also offers management an opportunity to systematically assess projects against predetermined performance criteria, and to adjust (accelerate or decelerate) schedules, redirect work, or, if appropriate, to terminate activities or projects.

2.3 Program Analysis

Each step in the planning process requires analysis. Planning takes place in a context of imperfect information. To the extent that there are large unknowns with potentially large impacts on the goals, objectives, or R&D portfolio, further analysis can help to bound, or even determine the impact on the BT program. Analysis is needed to help the Program Manager make informed choices.



Examples of past analyses that have guided programmatic decisions as to which R&D areas to pursue include the reports submitted to Congress in response to Sections 127 and 128 of the Energy Policy Act of 1992. More recently, a series of reports that examine the market for solid-state lighting are helping to suggest program directions in this important initiative. The BT Program Manager also uses tools, such as the residential Building Energy Optimization Tool (BEOpt), to examine options and suggest hypothetical optimal technology packages with the potential of meeting performance targets leading to achievement of ZEB; in this case in residential buildings.

Analysis is the core of some programmatic activities. Appliance standards rulemaking and model building codes development both rely on analysis to determine economically justified levels of codes and standards. In both cases, the analysis determines the target levels for codes and standards, while the actual levels are set in an open and cooperative process with stakeholders and industry.

Analysis is also needed at the project level to aid in proposal selection. Competing proposals will be difficult to judge without a common framework for assessing impacts. While proposers are required to submit estimated impacts using a standard calculation methodology and set of underlying assumptions, BT is also in the process of developing a common analysis framework to judge the potential impacts of competing proposals.

BT has a long history of conducting analysis and publishing the results. Appendix B includes many of the recently completed analysis and documents.

2.4 Performance Measurement

BT has developed main performance measures used by the program to determine its progress, which include the following:

- Residential Buildings Integration R&D Activities: Performance indicators include the number of: subsystem technological solutions developed, researched, and evaluated; design packages developed, researched, and evaluated against the Building America benchmark for homes; design packages developed and number of existing homes retrofitted to achieve 20 percent or more improvement in energy efficiency; project and demonstration homes developed in the Building America Program; building code change proposals developed and submitted to code development bodies; and upgrades of Federal building codes completed.
- Commercial Buildings Integration R&D Activities: Performance indicators include the number of: technology packages developed, researched, and evaluated on their demonstrated potential to contribute to a 50 percent reduction of energy use in new buildings; building code change proposals developed and submitted to code development bodies; and upgrades of Federal building standards issued.
- Emerging Technologies Activities: Performance indicators include the number of potentially market viable technologies demonstrated and patents awarded.
- Equipment Standards and Analysis: Performance indicators include: product standards and test procedures proposed/issued; and analyses completed for labeling and ENERGY STAR® update and expansion to include new products.



2.5 Performance Assessment

The basic types of performance assessments used by BT include:

Results-based performance reporting using DOE’s Joule Performance Measurement Tracking System, R&D Investment Criteria, and the White House Office of Management and Budget’s (OMB) Program Assessment Rating Tool (PART). The DOE Joule system tracks progress toward annual performance targets through reporting on verifiable quarterly milestones tied to targets. Projects that are under performing are put on a watch list and are required to address deficiencies through tracked action plans. Projects that have succeeded, or have reached a logical maturation, are considered for off-ramps (hand-offs to other governmental or non-governmental organizations or to the private sector). BT is building “off ramps” into its technical pathways by developing sustainable exit strategies to enhance technology transfer and transition to market.

PART, which incorporates key elements of the R&D Investment Criteria, is a guiding system for project evaluation. While these tools are applied at the program-level, the data necessary for completing PART are gathered and evaluated at the project level.

Peer reviews by outside independent experts of both program and subprogram portfolios to assess quality, productivity, and accomplishments; relevance of program success to EERE strategic and programmatic goals; and management.⁷ BT also uses the peer review process to judge both the merit of individual projects as well as the technical soundness of the overall portfolio. At key intervals, comprehensive reviews are conducted, supported by analysis and objective review and recommendations by panels of experts (merit review/peer review). The frequency, regularity, depth, and degree of independence of these reviews depend on the nature of the program, degree of technology change or evolution, the program’s performance and results and interest among the stakeholders. In response to peer review results, Technology Development Managers formulate Peer Review Implementation Plans that factor into planning, budget and execution decisions by the BT Program Manager. In accordance with EERE guidelines, the entire BT program will be reviewed every two years.

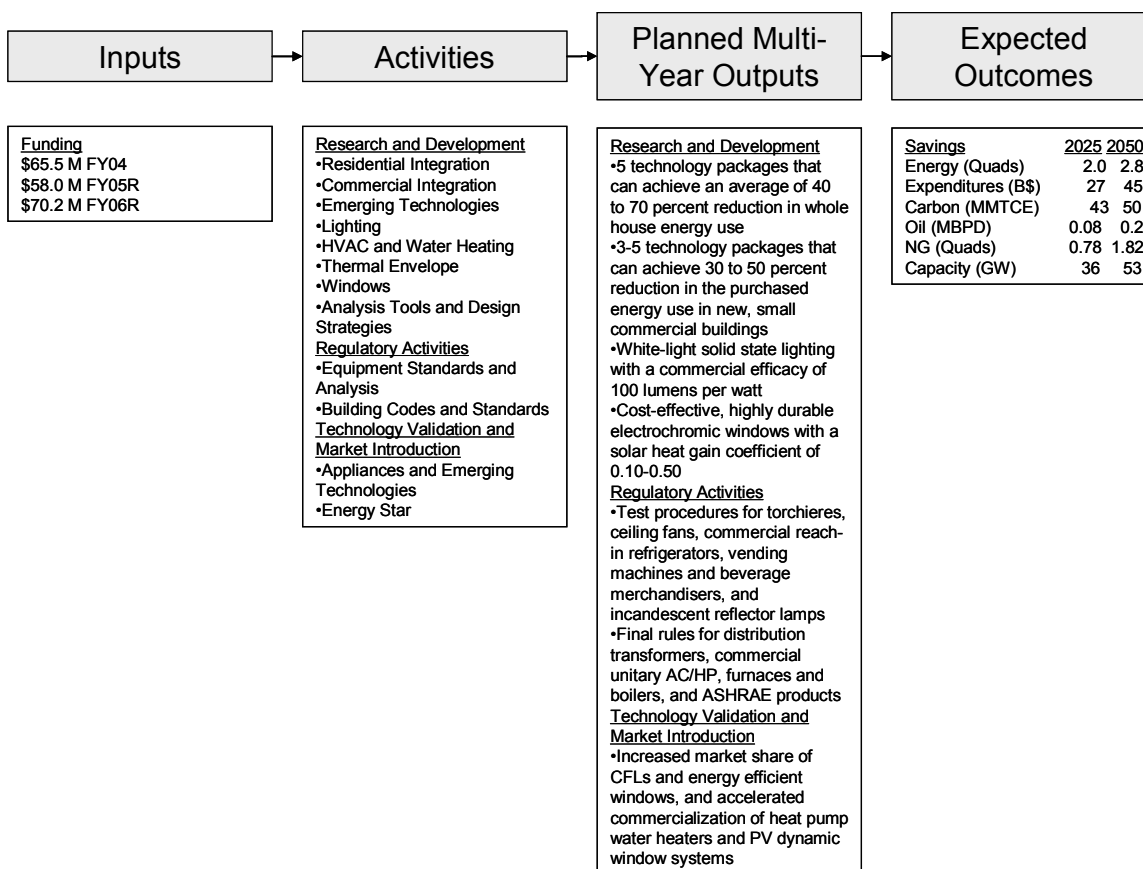
The results of these reviews help complete the program management cycle by feeding back into the strategic planning and multi-year planning processes. Performance is also a criterion in project selections. And performance evaluation is used to reshape plans, reassess goals and objectives, and re-balance the overall portfolio. To be included in the planning cycle, performance data (performance against milestones) have to be provided by December of each year.

2.6 Logic Models

⁷ [Peer Review Guide, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, August 2004.](#)



Figure 2-2 Building Technologies Logic Model⁸



2.7 Program Benefits

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, oil savings, natural gas savings, and the reduced need for electricity capacity additions that have the potential to result from the realization of Building Program goals are shown in Table 2-1 below through 2050. In addition to the types of benefits quantified above, building efficiency and renewable technologies often provide non-energy benefits, such as improved lighting quality and building occupant productivity. The benefits estimates reported in this table do not include any expected acceleration in the deployment of these new technologies due to the unique field partnerships that provide the basis for the Residential Building Integration R&D, or synergies with the EPA Energy Star® Home Program.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis (essentially the EIA business as usual outlook for components of the economy affecting energy use -- this includes competing technologies). In addition, possible changes in public policy and

⁸ Developed by the Office of PBFA.



disruptions in the energy system which may affect estimated benefits are not modeled. External factors, such as unexpected changes in competing technology costs, could also affect the Program's ability to achieve its strategic goals.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve in an orderly way. Estimated benefits, which follow, assume that individual technology plans and market assumptions obtain. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at <http://www1.eere.energy.gov/ba/pba/gpra.html>.

Table 2-1 FY2006 GPRA Benefits Estimates for the Buildings Program⁹

Mid-Term Benefits¹⁰	2010	2015	2020	2025
Primary nonrenewable energy savings (Quads).....	0.1	0.3	0.6	1.2
Energy bill savings (Billion 2002\$)	2	5	8	12
Carbon emission reductions (MMTCE).....	2	6	14	28
Oil savings (MBPD).....	0.01	0.02	0.03	0.02
Natural gas savings (Quads).....	0.05	0.10	0.14	0.28
Total electric capacity displaced (GW).....	ns	9	19	36

Long-Term Benefits¹¹	2030	2040	2050
Primary nonrenewable energy savings (Quads).....	2.4	3.5	4.2
Energy system cost savings (Billion 2001\$).....	29	43	62
Carbon emission reductions (MMTCE).....	45	64	92
Oil savings (MBPD).....	0.1	0.1	0.1
Natural gas savings (Quads).....	1.42	2.26	1.38
Total electric capacity displaced (GW).....	62	76	108

⁹ Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at the FY 2006 request level for the life of the program.

¹⁰ Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.

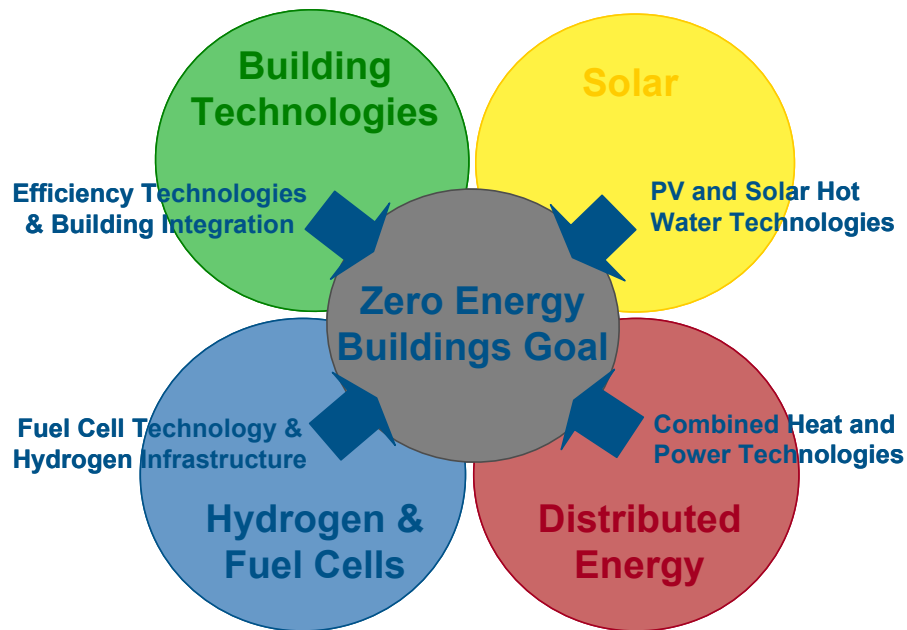
¹¹ Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.



2.8 Relationship to Other EERE, DOE and Federal Programs

Equally important, intra- and inter-agency collaboration and coordination are critical drivers for innovation. For example, EPA Energy Star Homes serves as a deployment mechanism for Building America research products. The success of ZEB depends not only on the BT program itself, but also relies on the successful development of renewable energy technologies and various initiatives in other EERE programs (see Figure 2-3).

Figure 2-3 EERE Programs Contributing to ZEB



The renewable energy technologies needed to achieve ZEB include low-cost photovoltaic (PV) in Solar, gas absorption breakthroughs in Distributed Energy and Electric Reliability (DEER), in Geothermal, in Hydrogen, in Wind and Hydropower, and in Biomass. Deployment and demonstration in Federal Energy Management Program (FEMP) and Weatherization and Intergovernmental Program (WIP) will also be needed to reach ZEB. These EERE programs must optimally align their missions and core capabilities with those of other programs, as well as, reach their cost and performance goals in order for BT to achieve its goal of ZEB.

The BT Program Manager recognizes that successfully achieving the program goals requires resources and successes outside the BT program. Some of these resources and efforts reside in other TD programs. BT's multi-year planning process makes these connections explicit. In other cases, BT contributes to mission goals for other TD programs or for cross-cutting goals for EERE as a whole. In both cases, the BT Program Manager works with the Deputy Assistant Secretary for Technology Deployment and other TD Program Managers to identify and manage these interrelationships in an integrated corporate-level multi-year plan.

